ANL-6612

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Argonne National Laboratory

PHYSICS DIVISION

SUMMARY REPORT

September-October 1962

ANL-6612
Physics
AEC Research and
Development Report

ARGONNE NATIONAL LABORATORY
9700 South Cass Avenue
Argonne, Illinois

PHYSICS DIVISION
SUMMARY REPORT

September-October 1962

Morton Hamermesh, Division Director

Preceding Summary Reports:

ANL-6534, April-May 1962
ANL-6574, June 1962
ANL-6603, July-August 1962

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FOREWORD

The Summary Report of the Physics Division of the Argonne National Laboratory is issued monthly for the information of the members of the Division and a limited number of other persons interested in the progress of the work. Each active project reports about once in 3 months, on the average. Those not reported in a particular issue are listed separately in the Table of Contents with a reference to the last issue in which each appeared.

This is merely an informal progress report. The results and data therefore must be understood to be preliminary and tentative.

The issuance of these reports is not intended to constitute publication in any sense of the word. Final results either will be submitted for publication in regular professional journals or, in special cases, will be presented in ANL Topical Reports.

FOREWORD

The Summary Report of the Physics Division of the Argonne National Laboratory is issued primarily for the information of the members of the Division and a limited number of other persons interested in the progress of the work. Each active project reports about once in six months, on the average. These are reported in parts and are listed separately in the Table of Contents with a reference to the issue in which each appeared.

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TABLE OF CONTENTS

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PROJECTS NOT REPORTED IN THIS ISSUE

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I. EXPERIMENTAL NUCLEAR PHYSICS

I-2. Neutron Detectors (ANL-6534, April-May 1962), L. M. Bollinger and G. E. Thomas.

I-3. Cross-Section Measurements with the Fast Neutron Velocity Selector (ANL-6534, April-May 1962), L. M. Bollinger, R. E. Cote', H. E. Jackson, J. P. Marion, and G. E. Thomas.

I-7. Gamma-Ray Spectra from Capture in Neutron Resonances (ANL-6603, July-August 1962), H. E. Jackson.

I-10. Tandem Van de Graaff Accelerator (ANL-6262, December 1960), F. P. Mooring and J. R. Wallace.

I-11. Installation and Operation of the Van de Graaff Generator (ANL-6488, January 1962), J. R. Wallace.

I-14. Pulsed Beams for the Van de Graaff Machine (ANL-6391, July-August 1961), R. E. Holland and F. J. Lynch.

I-18. Neutron Polarization and Differential Cross Sections (ANL-6603, July-August 1962), A. J. Elwyn, R. O. Lane, and A. Langsdorf, Jr.

I-19. Nuclear Resonance Absorption of Gamma Rays (ANL-6603, July-August 1962), R. S. Preston, S. S. Hanna, and J. Heberle.

I-21. Excited States of Light Nuclei (ANL-6603, July-August 1962), J. A. Weinman, L. Meyer-Schützmeister, and L. L. Lee, Jr.

I-22. Scattering of Charged Particles (ANL-6574, June 1962), H. W. Broek and J. L. Yntema.

II-39. Fragmentation of Cyanogen (ANL-6488, January 1962), H. E. Stanton.

II-40. Fragmentation of Hydrocarbons (ANL-6534, April-May 1962), H. E. Stanton.

II-41. Consecutive Ion-Molecule Reactions (ANL-6603, July-August 1962) S. Wexler.

IV. PLASMA PHYSICS

IV-10. Morphology of High-Frequency Plasmoids (ANL-6574, June 1962), A. J. Hatch.

V. THEORETICAL PHYSICS, GENERAL

V-1. The Deformation Energy of a Charged Liquid Drop (ANL-6432, September-October 1961), S. Cohen and W. J. Swiatecki.

V-3. Dynamics of Nuclear Collective Motion (ANL-6517, February-March 1962), D. R. Inglis.

V-4. Relative β-Decay Probabilities for $_{19}K^{40}$ (ANL-6455, November-December 1961), D. Kurath.

V-9. Interpretation of Experiments Involving Excitation of the 15.1-MeV Level of C^{12} (ANL-6391, July-August 1961), D. Kurath.

V-12. Seniority Mixing in $1f_{7/2}$ Nuclei (ANL-6574, June 1962), R. D. Lawson and B. Zeidman.

V-15. Statistical Properties of Nuclear Energy States (ANL-6488, January 1962), N. Rosenzweig.

V-26. Preacceleration in Electron Theory (ANL-6603, July-August 1962), M. N. Hack.

ERRATUM

I-21-9 Excited States of Light Nuclei (51210-01)

J. A. Weinman, L. Meyer-Schützmeister,
and L. L. Lee, Jr.

The following is the figure that should have been given on p. 52 of ANL-6603, Physics Division Summary Report, July-August 1962.

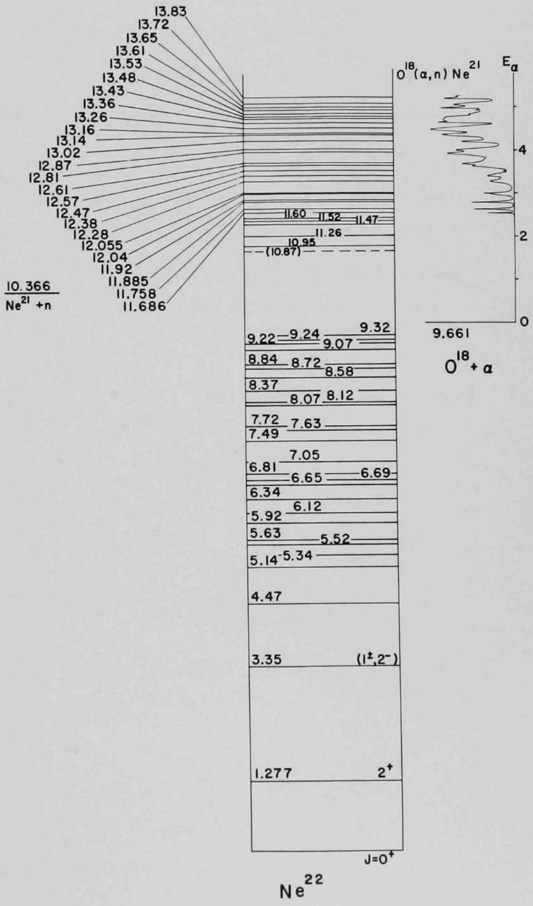

Fig. 20. Energy-level scheme of Ne^{22} as of May 1962.

I. EXPERIMENTAL NUCLEAR PHYSICS

I-24-2 Studies of Pickup Reactions (51210-01)

B. Zeidman and T. H. Braid

(d, He^3) REACTIONS ON F^{19} AND Al^{27}

We have measured angular distributions in the $F^{19}(d, He^3)O^{18}$ and $Al^{27}(d, He^3)Mg^{26}$ reactions initiated by 21.6-MeV deuterons from the Argonne 60-inch cyclotron. The He^3 particles were detected and distinguished from other reaction products by a pair of solid-state counters (which measured dE/dx and E) feeding into a pulse multiplier giving an output pulse proportional to MZ^2. The resolution of this system was sufficiently good that the He^3 particles were cleanly separated from the α particles from the (d, α) reaction. Since the energy loss in the dE counter is quite large, the fluctuations in that loss are reflected in a degradation of the energy resolution from the E counter. Therefore the spectra were taken by adding the outputs from the two counters to obtain $E_T = dE + E$, in which case the energy resolution is unimpaired. Figure 1 shows an example of the spectra obtained. It is seen that He^3 groups corresponding to Q values as large as -10 MeV can be detected.

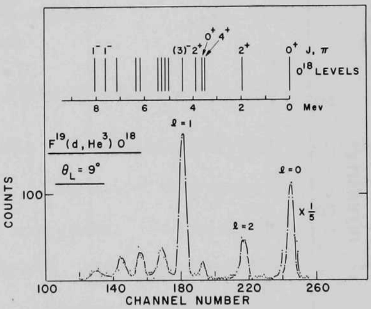

Fig. 1. Spectrum of $F^{19}(d, He^3)O^{18}$ at $\theta_L = 9^o$.

The groups observed from the F^{19} target correspond to excitation of O^{18} to energies of 0, 1.98, 3.68, 4.45, 5.43, 6.32, 7.0, and 8.0 MeV, all of which may be understood in terms of known levels, as illustrated in Fig. 1. From the Al^{27} target, five groups have been observed. These correspond to excitations in Mg^{26} of 0, 1.83, 2.94, 4.35, and 5.6 MeV. Spectra have been measured over an angular range from 9° to 42° in steps of 2—4°, and the angular distributions of the prominent peaks have been compared with Butler curves calculated for angular-momentum transfer of ℓ = 0, 1, and 2. The transition to the O^{18} ground state ($J = \frac{1}{2}^{+} \rightarrow 0^{+}$) must proceed via an ℓ = 0 pickup, and the ground-state transition to Mg^{26} ($J = \frac{5}{2}^{+} \rightarrow 0^{+}$) must proceed via an ℓ = 2 pickup. Figure 2 shows that the agreement in these two cases is excellent and we therefore feel justified in using the calculated curves to determine the ℓ values in the case of other levels. Three other prominent peaks from Al^{27}, corresponding to the 2^{+} first and second excited states and to one or more of a group of states near 4.3 MeV, also proceed by ℓ = 2 pickup.

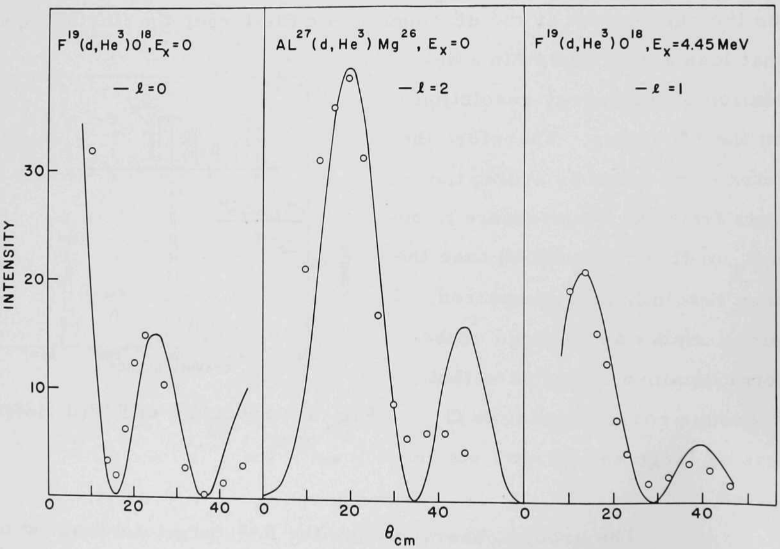

Fig. 2. Angular distributions from the indicated (d, He^3) reactions. The theoretical curves are Butler curves without form factor.

The distribution of the group going to the first excited state in O^{18} also must be $\ell = 2$, and does indeed give a good fit to the calculated curve. The presence of both s and d pickup illustrates the mixing of these configurations in F^{19}. The state observed at 4.45 MeV in the $O^{16}(d,p)O^{18}$ reaction[1] has been tentatively reported to have a spin $J = 3^-$. However, the angular distribution (Fig. 2) clearly conforms to $\ell = 1$. This corresponds to the pickup of a p proton, leading to a spin J = 0, 1, or 2, but not 3, and would indicate that the state is a single-particle hole state in the p shell. Other peaks appear to include contributions from more than one closely-spaced level and, to some extent at least, mixtures of ℓ values result.

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[1] A. A. Jaffe, I. J. Taylor, and P. D. Forsyth, Proc. Phys. Soc. (London) 76, 914 (1960).

I-80-31 **Molecular Beam Studies** (51210-01)

William Childs, John Dalman, Dieter von Ehrenstein, and Leonard Goodman
Reported by William Childs

1. OPERATION OF THE MARK I ATOMIC-BEAM MACHINE

The Mark I machine has been used extensively for investigating the radioactive nuclei In^{110} and Cr^{51}. The In^{110} was produced in the Argonne cyclotron by the $Ag^{107}(\alpha, n)In^{110}$ reaction. To obtain the maximum cross section for production of the In^{110}, the alpha beam was slowed to 16 MeV by aluminum foil in the target "sandwich". Because of the 66-min half-life of the indium, fast chemistry was required to separate it (with indium carrier) from the target before it could be loaded into the atomic-beam machine. Although about 20 runs were made, a definitive spin determination was not possible because of inadequate counting rate. It is hoped ultimately to use the Mark II machine for this isotope in the hope that its sevenfold increase in transmission would make the experiment possible.

Although the nuclear spin of 28-day Cr^{51} is known[1] to be 7/2, no measurement has been made of its hyperfine interaction. Reasonable amounts of the Cr^{51} can be produced with the flux available at CP-5. A number of recent runs have enabled us to trace one of the double-quantum, $\Delta F = 0$ transitions up to 60 Mc/sec, where its frequency at a known field has been measured to about 1 part in 4000. Work is proceeding well and it should soon be possible to quote a good value for the hyperfine interaction and a rough value for the magnetic dipole moment.

2. PROGRESS WITH THE MARK II MACHINE

The backward-forward synchronous scaling system for use with the universal detector has been described previously.[2] It has now been successfully used to detect beams and resonances of K^{39}, Na^{23}, Cs^{133}, and $Cr^{52, 53}$. Figure 3 shows a block diagram of the arrangement. It will be seen that the 28.6-cps modulation used can be introduced either by square-wave modulation of the rf signal used to induce the resonance, or by square-wave modulation of the atomic beam itself (with a mechanical chopper). In either case, because signal-to-noise ratios of only 0.001 will be common, it has been found essential to require the square wave to be extremely pure. The positive and negative half cycles of the square wave used for modulation of the rf, for example, are of identical duration to within a few parts in 10^6.

Figure 4 shows resonances observed (with the universal detector) for which the signal-to-noise ratio varies from 1.5 down to 10^{-4}. In order to obtain a meaningful curve under such adverse conditions as those for the bottom panel, great stability is required in both the detector

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[1] W. J. Childs, L. S. Goodman, and L. J. Kieffer, Bull. Am. Phys. Soc. 3, 151 (1959).

[2] W. Childs, J. Dalman, D. von Ehrenstein, and L. Goodman, Physics Division Summary Report ANL 6517 (Feb.-March, 1962), p. 36.

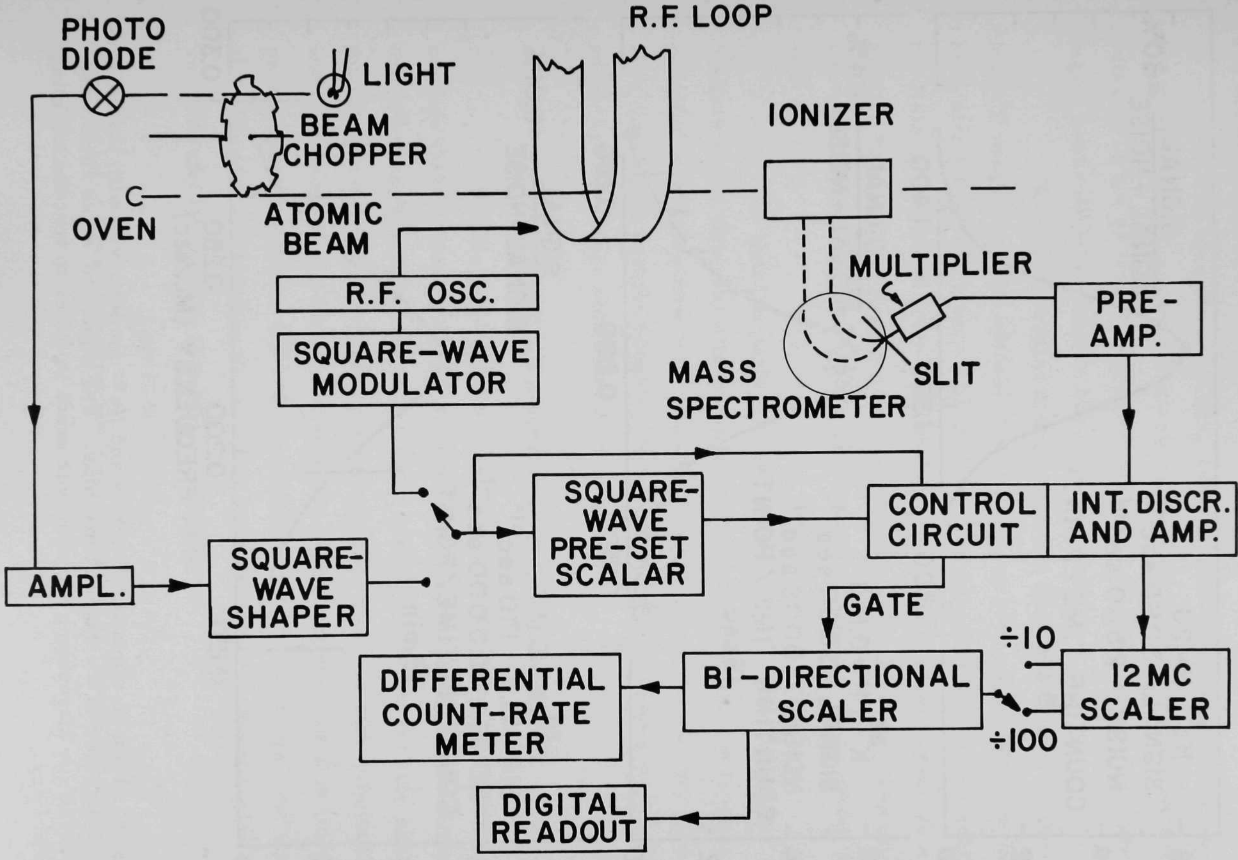

Fig. 3. Block diagram of the electronics associated with the electron-bombardment universal detector of the Mark II machine. Examples of resonances observed with this detector are shown in Fig. 4.

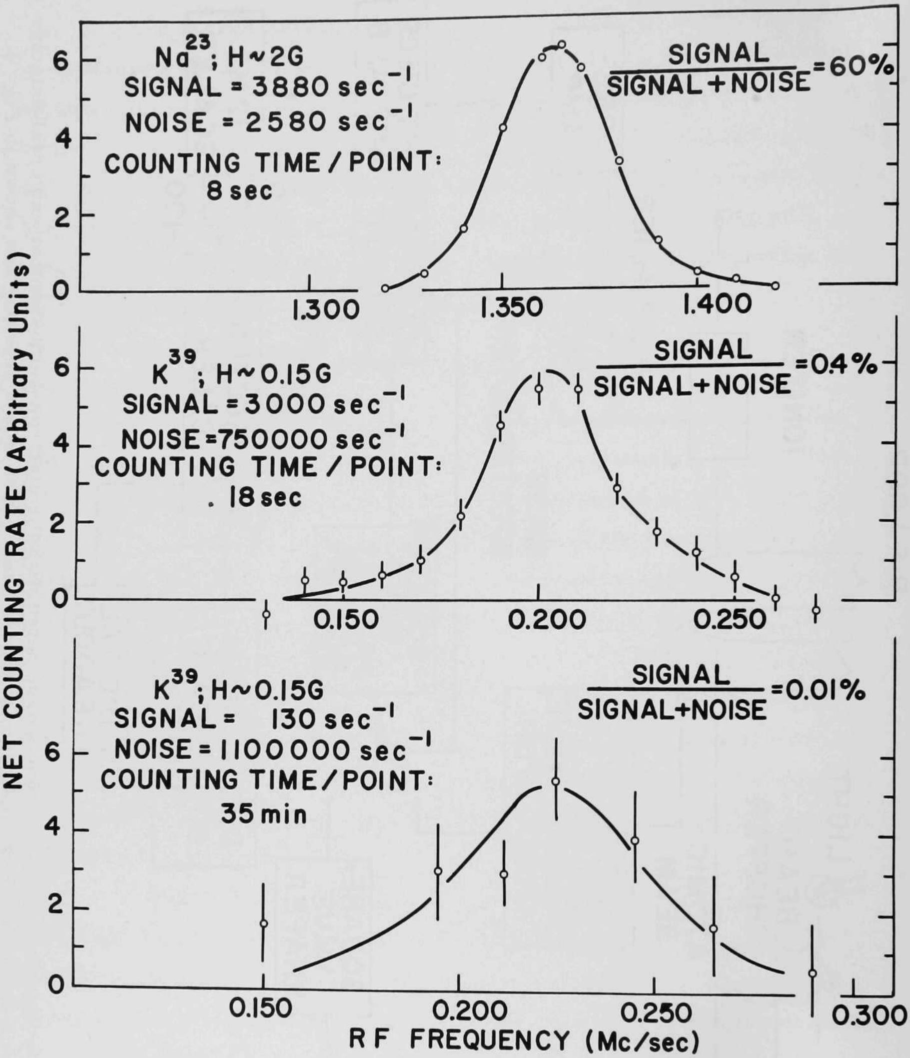

Fig. 4. Flop-in transitions in K^{39} and Na^{23} as observed with the universal detector of the Mark II machine. The signal-to-noise ratio was varied (by attenuating the rf power used) in order to test the counting circuitry.

and the atomic beam.

The maximum counting rate for ions (when evenly spaced) is 1.3×10^7 /sec. Counting losses introduced by the nonuniform spacing of pulses will not be troublesome for this application if the counting rate remains reasonably constant in time, as it should.

Several mechanical improvements have been made on the Mark II machine. The system of magnetic analysis of the ion beam has been altered in such a way that the radius of curvature of the ion orbits in the field is increased from 4 in. to 12.5 in. The principal result is a greatly increased efficiency for collecting the analyzed ions. The other changes planned[2] for the universal detector have not yet been made, however.

The most important recent addition to the machine is the installation of a differentially-pumped oven-loading system. It is now possible to insert a new oven into the machine (or remove an old one) in less than 5 min without breaking the vacuum. This will be a very great advantage for future operation of the machine.

3. NEW RESULTS FROM THE MARK II MACHINE

Preliminary work on resonances in the even-even stable nucleus Cr^{52} indicated that it should be possible to detect resonances in the 10% abundant odd-A nucleus Cr^{53}. Although the nuclear spin and dipole moment had previously been measured, the hyperfine interaction was unknown. Since the total electronic angular momentum J is integral, only multiple-quantum $\Delta F = 0$ transitions could be observed, but both flop-in and flop-out transitions of this kind were seen. Preliminary results indicate that the hyperfine interaction is

$$|a(Cr^{53})| = 88 \pm 6 \text{ Mc/sec.}$$

This result is consistent with the work reported above for the radioactive nucleus Cr^{51}.

V. THEORETICAL PHYSICS, GENERAL

V-2-18. Properties of Light Nuclei (51210-01)

Dieter Kurath

STRONG M1 TRANSITIONS IN LIGHT NUCLEI

The magnetic-dipole-moment operator can be split into two parts, one of which behaves like a scalar and the other like a vector in isobaric-spin space. Only the scalar part contributes to transitions between T = 0 states; and Morpurgo[1] has pointed out that since the neutron and proton spin contributions tend to cancel in the scalar part, transitions between T = 0 states should be weak. On the other hand, only the vector part contributes to transitions between T = 0 and T = 1 states, and in this term the neutron and proton spin contributions reinforce each other. This feature should permit strong transitions, and some properties of such transitions have been investigated.

An experimental means which is especially suited to selecting strong M1 transitions is the observation[2] of electrons inelastically scattered from nuclei at backward angles. Such experiments also permit the observation of such transitions in cases in which the other means (gamma decay of the nucleus) may be overwhelmed by instability to particle decay. Recent experiments[3] have treated several light nuclei, including B^{10} whose ground state has I = 3, T = 0. In B^{10} one observes strong M1 transitions to levels at 7.9, 11.8, and 14 MeV. After the energy dependence has been extracted, the reduced transition probabilities

[1] G. Morpurgo, Phys. Rev. 110, 721 (1958).

[2] W. C. Barber, F. Berthold, G. Fricke, and F. E. Gudden, Phys. Rev. 120, 2081 (1960).

[3] R. D. Edge and G. A. Peterson (private communication).

B(M1;30 → IT) of these levels are (8.8 ± 20%), (6.2 ± 50%), and (3.1 ± 50%), respectively.

Reduced transition probabilities, calculated with intermediate-coupling functions, have been obtained for transitions connecting the ground state of B^{10} to various T = 1 states. The results are summarized in Table I. Comparison with experiment indicates probable identifications of the 7.9-MeV transition as the one to the second calculated (I = 2, T = 1) state, the 11.8-MeV transition as going to the lowest (I = 3, T = 1) state, and the 14-MeV transition as involving either the third (I = 2, T = 1) state or the lowest (I = 4, T = 1) state or both. One point to note is that although there are 14 states with (I = 2, T = 1) some 95% of the transition strength is concentrated in a few low levels. A similar concentration occurs for the I = 3 and I = 4 states, as indicated by the percentages listed in Table I.

Such concentration of transition strength also occurs in the 4N nuclei for which the transition occurs from the (I = 0, T = 0) ground state. Transitions in these nuclei are sensitive indicators of the degree of spin-orbit coupling, and the energy-weighted sum rule for such M1 transitions can be used to exhibit this property explicitly.[4] Therefore in the (2s - 1d) shell, one would expect especially large transition strengths in nuclei whose structure best approximates a full $1d_{5/2}$ shell and an empty $1d_{3/2}$ shell.

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[4] D. Kurath, Bull. Am. Phys. Soc. 7, 539 (1962).

TABLE I. Reduced transition probability B(M1) for magnetic-dipole transitions from the ground state (I = 3, T = 0) of B^{10} to various excited states having T = 1. The states and their approximate excitation energies are identified on the left. Values of B(M1) are given as functions of the relative strength (a/K) of spin-orbit coupling. The percentage of total B(M1;3 → I) which is concentrated in the listed transitions is also given.

		a/K		
I	E (MeV)	3.0	4.5	6.0
2	5	0.85	0.06	0.11
2	7.5	12.98	11.66	11.00
2	12.5	2.06	2.78	2.91
		94%	95%	96%
3	10.5	4.99	6.39	7.07
3	16	0.08	0.68	1.59
		90%	92%	95%
4	12	0.40	1.03	1.63
4	16	0.06	0.03	0.02
		80%	90%	93%

V-5-2. Geometric Properties of Angular Distributions of Decay Products (51210-01)

Murray Peshkin

It was reported earlier[1-3] that, when an unstable particle is created in a reaction involving few quantum states, the angular distribution of its decay products depends upon the number of states involved in the production process. It was learned, for instance, that when the spin s of the unstable particle is larger than the number of states in the production process, the decay cannot be isotropic.

These methods have now been extended to the parity-mixing decay

$$\Xi^- \rightarrow \Lambda^0 + \pi^- \tag{1}$$

following the production reaction

$$K^- + p \rightarrow \Xi^- + K^+ . \tag{2}$$

Let the angular distribution of π^- in decay (1) be written in the form

$$I(\theta, \phi) = \sum_{L, M} a(L, M)\, Y_{LM}(\theta, \phi) . \tag{3}$$

It is found that the asymmetry coefficients a(L, M) must obey certain relations which depend upon the spin s of the Ξ^-. These new relations

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[1] P. Eberhard and M. L. Good, Phys. Rev. 120, 1442 (1960).

[2] M. Peshkin, Physics Division Summary Report ANL-6288 (January-February, 1961), p. 13.

[3] M. Peshkin, Phys. Rev. 123, 637 (1961).

are considerably more restrictive than the relations of Lee and Yang,[4] which are conventionally used to test the Ξ^- spin. The most important new result is that the angular distribution

$$I(\theta, \phi) = 1 + A \cos \theta \tag{4}$$

with $|A| > 0$ implies unambiguously that $s = \frac{1}{2}$. The most promising previous analysis[4] could exclude a given value of s only if $|A| > 1/(6s)$.

A paper reporting these results in detail, entitled "Possible Determination of the Spin of the Ξ^- from the Angular Distribution of Its Decay," has been submitted for publication.

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[4] T. D. Lee and C. N. Yang, Phys. Rev. 109, 1755 (1958).

V-25-2. Scattering of Alpha Particles by a Vibrational Nucleus

(51210-01)

L. J. Tassie

This project has been completed and the results have been published in a report entitled "Scattering of Alpha Particles by a Vibrational Nucleus," Australian J. Phys. 15, 135-142 (June 1962).

PUBLICATIONS SINCE THE LAST REPORT

PAPERS

HEAT OF FORMATION OF THE CN RADICAL
J. Berkowitz . . . . (Project II-29)
J. Chem. Phys. 36, 2533-2539 (May 15, 1962)

CHARGE STRUCTURE OF THE NUCLEON
K. Hiida . . . . (Project V-47)
Phys. Rev. 127, 2231-2235 (September 15, 1962)

RESONANT ABSORPTION OF NEUTRONS BY CRYSTALS
H. E. Jackson and J. E. Lynn . . . . (Project I-7)
Phys. Rev. 127, 461-468 (July 15, 1962)

ENERGY-DEPENDENT MULTIPLE SCATTERING OF NEUTRONS IN THIN PLATES
R. O. Lane and W. F. Miller (AMD) . . . . (Project I-18)
Nuclear Instr. and Methods 16, 1-16 (1962)

HIGH-ENERGY GAMMA RAYS FROM Na^{24}
J. E. Monahan, S. Raboy, and C. C. Trail . . . (Project I-55)
Nuclear Phys. 33, 633-638 (1962)

FLUX QUANTIZATION AND TIME-REVERSAL DEGENERACY
M. Peshkin and W. Tobocman (Case Inst. of Techn.). . (Project V-33)
Phys. Rev. 127, 1865-1867 (September 15, 1962)

SPIN AND STATISTICS WITH AN INDEFINITE METRIC
R. Spitzer . . . . (Project V-39)
Nuclear Phys. 33, 614-625 (1962)

A NOTE ON THE SUPERSELECTION RULES FOR SPIN-$\frac{1}{2}$ BOSONS
R. Spitzer . . . . (Project V-39)
Phys. Letters 2, 102 (August 15, 1962)

SIMPLIFICATION OF CARATHÉODORY'S TREATMENT OF THERMODYNAMICS. II
L. A. Turner (LDO) . . . . (Unattached)
Am. J. Phys. 30, 506-508 (July 1962)

THIN dE/dx COUNTER WITH LARGE APERTURE
J. A. Weinman and R. K. Smither . . . . (Project I-16)
Rev. Sci. Instr. 33, 653-654 (June 1962)

THE ARGONNE 60-IN. SCATTERING CHAMBER
J. L. Yntema and H. W. Ostrander (CS) . . . . . (Project I-22)
Nuclear Instr. and Methods 16, 69-88 (1962)

CO-OP STUDENT REPORTS

THE CHLORINE CONTENT OF METEORITES
W. C. McKee . . . . (Project II-34)
Co-op Student Report to the Missouri School of Mines and Metallurgy, September 1962

A COMPUTER PROGRAM FOR DATA ANALYSIS IN A NEUTRON SCATTERING EXPERIMENT
D. J. Mueller . . . . (Project I-18)
Co-op Student Report to Northwestern University, August 31, 1962

DEUTERON-STRIPPING REACTIONS
R. L. Obenchain . . . . (Project I-31)
Co-op Student Report to Northwestern University, August 24, 1962

M. S. THESIS

A STUDY OF THE MÖSSBAUER EFFECT FOR Fe^{57} IN Be, Cu, W, AND Pt
P. N. Parks . . . . (Project I-19)
M. S. Thesis, Michigan College of Mining and Technology (1962)

ADDITIONAL PAPERS ACCEPTED FOR PUBLICATION

MASS SPECTROMETRIC STUDY OF THE MAGNESIUM HALIDES
J. Berkowitz and J. R. Marquart . . . . (Project II-29)
J. Chem. Phys. (October 1962)

POLARIZATION AND DIFFERENTIAL CROSS SECTIONS IN n-d SCATTERING
A. J. Elwyn, R. O. Lane, and A. Langsdorf, Jr. . . (Project I-18)
Phys. Rev. (October 15, 1962)

MASS SPECTRA RESULTING FROM HIGH-ENERGY ELECTRON IMPACT ON SOME HYDROCARBON MOLECULES
J. E. Monahan and H. E. Stanton . . . . (Project II-40)
J. Chem. Phys. (December 1, 1962)

THE MÖSSBAUER EFFECT IN METALLIC IRON
R. S. Preston, S. S. Hanna, and J. Heberle . . . (Project I-19)
Phys. Rev. (December 1, 1962)

POSSIBLE INTERPRETATIONS OF HIGH-ENERGY CROSS SECTIONS
K. Tanaka . . . . (Project V-45)
Nuovo cimento (October 1962)

A BORON-LOADED LIQUID SCINTILLATION NEUTRON DETECTOR USING A SINGLE PHOTOMULTIPLIER
G. E. Thomas . . . . (Project I-22)
Nuclear Instr. and Methods

PERSONNEL CHANGES IN THE ANL PHYSICS DIVISION

NEW MEMBERS OF THE DIVISION

Staff Members

Dr. Herbert H. Bolotin. Born in New York City, New York, 1930. Married; 2 children: Andrew, 6, and Allison, 2. Home address: 6928 S. Paxton Avenue, Chicago, Illinois. Ph.D., Indiana University, Bloomington, Indiana, 1955. He joined the Physics Division on August 17, 1962. His main areas of interest are neutron-capture γ rays and other problems in nuclear structure.

Dr. Donald S. Gemmell. Born in Adelaide, South Australia, 1934. Married; one daughter, Susan, 2 years old. Home address: 39 North Adams Street, Westmont, Illinois. Ph.D., Australian National University, Canberra, Australia, 1960. Research Fellow at A.E.R.E., Harwell, England, from 1960–1962. He joined the Physics Division on September 26, 1962 to do research with the 4-MeV Van de Graaff and the 12-MeV tandem generator.

Dr. Victor E. Krohn. Born in Milwaukee, Wisconsin, 1924. Home address: 4725 Linscott, Downers Grove, Illinois. Ph.D., Case Institute of Technology, 1952. He was at ANL from 1952–1958 and returned to the Physics Division on August 28, 1962 primarily to do experiments with thermal neutrons.

Dr. Malcolm H. Macfarlane. Born in Brechin, Angus, Scotland, 1933. Married; one daughter, Sheila 1 year old, and two sons, Kenneth $2\frac{1}{2}$ years old and Douglas 4 years old. Home address: 7031 Golf View Road, LaGrange, Illinois. Ph.D., University of Rochester, 1959. He was a resident research associate in 1959–1960. He joined the Physics Division on August 31, 1962 to continue theoretical studies of nuclear structure and low-energy nuclear reactions.

Resident Research Associates

Dr. Charles E. Johnson, Senior Research Fellow, A.E.R.E., Harwell, England. Mössbauer effect. Came to Argonne on September 10, 1962. (Host: G. J. Perlow.)

Dr. Alvin M. Saperstein, Assistant Professor, University of Buffalo. Composite particles in abstract field theory. Came to Argonne on September 18, 1962. (Host: M. Hamermesh.)

Student Aides (Co-op)

Mr. Geoffrey Garrett, Antioch College, Working with R. O. Lane on neutron polarization and differential cross sections. Came to ANL on October 1, 1962.

Mr. James L. Witte, Aquinas College, Michigan. Working with J. P. Schiffer on the elastic scattering of protons. Came to ANL on September 4, 1962.

Student Aides (ACM)

Mr. Erlan Bliss, Lawrence College, Appleton, Wisconsin. Working with M. S. Kaminsky on mass spectrometric studies of the permeability of alkali salts through noble metals and tungsten. Came to ANL on September 4, 1962.

Mr. William Denno, Kalamazoo College, Kalamazoo, Michigan. Working with S. S. Hanna on the Mössbauer effect in iron and its compounds. Came to ANL on September 4, 1962.

Mr. William E. Gelhaar, Knox College, Galesburg, Illinois. Working with S. B. Burson on checking out the angular-correlation apparatus and on an experimental study of the decay schemes of W^{188} and Re^{188}. Came to ANL on September 4, 1962.

Mr. Melvin Pronga, Monmouth College, Monmouth, Illinois. Working with S. S. Hanna on the use of superconducting magnets in research with the Mössbauer effect. Came to ANL on September 4, 1962.

Technician

Mr. James Timm joined the Van de Graaff group on October 31, 1962.

Draftsman

Mr. David Lee Kurth joined the Physics Division on October 22, 1962.

DEPARTURES

Dr. Louis J. Basile, who joined the Physics Division in 1952 and has worked since then on plastic scintillators (Projects I-115, I-116, I-143, I-144), has transferred to the Chemistry Division where he will work on the chemistry of the actinide series. He left the Physics Division on September 4, 1962.

Mr. Robert Feiner, Research Technician, Jr., has been at Argonne since October 11, 1961. He terminated at ANL on August 24, 1962.

Mr. Teymoor Gedayloo, who has been a resident research associate since June 20, 1961, terminated on September 17 to return to Lawrence College, Appleton, Wisconsin. While at Argonne he supervised the physics students from the Associated Colleges of the Midwest and collaborated with S. B. Burson on the beta decay of W^{188} and on a computer program for the analysis of complex continuous beta-ray spectra. (Projects I-36 and I-38).

Mr. Manley S. Keeler, Research Technician, Jr., has been at Argonne since May 5, 1961. He terminated at ANL on September 10, 1962.

Mr. Richard W. Snyder, draftsman, has been at Argonne since October 2, 1961. He terminated at ANL on September 4, 1962.

Dr. Richard K. Spitzer, resident research associate from Purdue University, has been at Argonne since September 28, 1961. He has worked on spin and statistics with an indefinite metric (Project V-39), especially on the superselection rules for spin-$\frac{1}{2}$ bosons. He terminated at ANL on September 14, 1962 to return to Purdue University.